CLAIMS

1. A protein lattice having a regular structure with a repeating unit repeating in three dimensions,

the repeating unit comprising protein protomers which each comprise at least two monomers fused together, the monomers each being monomers of a respective oligomer assembly into which the monomers are assembled for assembly of the protomers into the lattice,

wherein the repeating unit comprises protomers comprising at least a first monomer which is a monomer of a first oligomer assembly which is symmetrical in three dimensions.

2. A protein lattice according to claim 1, wherein the first oligomer assembly has a set of rotational symmetry axes extending in three dimensions,

whereby said repeating unit includes protomers with the first monomers of the protomers being assembled into said first oligomer assembly and, in respect of respective ones of said set of rotational symmetry axes, with further monomers of the protomers fused to respective first monomers being arranged symmetrically around said respective one of said set of rotational symmetry axes.

3. A protein lattice according to claim 2, wherein, in said protomers, said further monomers are monomers of a further oligomer assembly which has a rotational symmetry axis of the same order as the respective one of said set of rotational symmetry axes of said first oligomer assembly,

whereby said repeating unit includes said protomers with said further monomers being assembled into respective further oligomer assemblies with said rotational symmetry axis of each respective further oligomer assembly being aligned with said respective one of said set of rotational symmetry axes of said first oligomer assembly.

4. A protein lattice according to claim 1, wherein the first oligomer assembly has a set of rotational symmetry axes extending in three dimensions, and, in said protomers, further monomers fused to said first monomers are monomers of respective further oligomer

assemblies which have a rotational symmetry axis of the same order as a respective one of said set of rotational symmetry axes of said first oligomer assembly,

whereby said repeating unit includes protomers with the first monomers of the protomers being assembled into said first oligomer assembly and, in respect of respective ones of said set of rotational symmetry axes, with further monomers of the protomers fused to respective first monomers being assembled into respective further oligomer assemblies with said rotational symmetry axis of said respective further oligomer assemblies being aligned with the respective rotational symmetry axis of said first oligomer assembly.

5. A protein lattice according to any one of claims 2 to 4, wherein the orders of the rotational symmetry axes of said set of rotational symmetry axes are a respective one of 2, 3, 4 or 6.

6. A protein lattice according to any one of claims 2 to 5, wherein each of said monomers of said respective oligomer assemblies either is a naturally occurring protein or is based on a naturally occurring protein with peptide elements being absent from, substituted in, or added to the naturally occurring protein without substantially affecting assembly of monomers of said respective oligomer assembly.

7. A protein lattice according to claim 6, wherein, in said protomers, said monomers are fused via a linking group.

8. A protein lattice according to claim 7, wherein the linking group is oriented relative to the first and further monomers in the protomer in its normal form prior to assembly to reduce any difference in the assembled lattice in either or both of the position and orientation of (a) the termini of said first monomers in their arrangement in said first oligomer assembly in its natural form symmetrically around said respective one of said set of rotational symmetry axes of said first oligomer assembly, and (b) the termini of said further monomers in their arrangement in said further oligomer assembly in its natural form symmetrically around said rotational symmetry axis of said respective further oligomer assembly.

9. A protein lattice according to any one of claims 3 to 8, wherein the protomers are homologous with respect to the monomers.

10. A protein lattice according to claim 9, wherein said first oligomer assembly belongs to either a tetrahedral point group or an octahedral point group.

11. A protein lattice according to claim 10, wherein said further oligomer assembly belongs to a dihedral point group of the same order as the respective one of said set of rotational symmetry axes of said first oligomer assembly.

12. A protein lattice according to claim 10, wherein said further oligomer assembly belongs to either a tetrahedral point group or an octahedral point group.

13. A protein lattice according to claim 9, wherein said first oligomer assembly belongs to a dihedral point group of order 3, 4 or 6, and said protomers comprise at least two further monomers with a further monomer fused to each terminus of said first monomer of said first oligomer assembly.

14. A protein lattice according to claim 13, wherein one of said further monomers is a monomer of an oligomer assembly which belongs to a dihedral point group of the same order as the dihedral point group to which the first oligomer assembly belongs.

15. A protein lattice according to claim 14, wherein the other of said further monomers is a monomer of an oligomer assembly which belongs to a dihedral point group of order 2.

16. A protein lattice according to any one of claims 3 to 8, wherein the protomers are heterologous with respect to the monomers.

17. A protein lattice according to claim 16, wherein the unit cell includes protein protomers of two types, wherein the two types of protomer include different monomers of the same heterologous oligomer assembly.

18. A protein lattice according to claim 17, wherein at least a first type of protomer constitutes said protomers with the first monomers of the protomers being assembled into said first oligomer assembly and said further monomers of the protomers fused to respective first monomers are one of said different monomers of the same heterologous oligomer assembly, said heterologous oligomer assembly belonging to a cyclic point group.

19. A protein lattice according to claim 18, wherein said first oligomer assembly of the first type of protomer belongs to either a tetrahedral point group or an octahedral point group.

20. A protein lattice according to claim 19, wherein the second type of protomer comprises a monomer which is a monomer of an oligomer assembly belonging to a dihedral point group of the same order as said heterologous oligomer assembly.

21. A protein lattice according to claim 18, wherein the second type of protomer comprises a monomer which is a monomer of an oligomer assembly belonging to either a tetrahedral point group or an octahedral point group.

22. A protein lattice according to any one of the preceding claims having an array of macromolecular entities attached thereto.

23. A protein lattice according to claim 22, wherein the protomers have, at a predetermined position in the protomers, an affinity tag attached to a macromolecular entity.

24. A protein lattice according to claim 22 or 23, wherein the macromolecular entities have a peptide affinity tag attached to one of the protomers in the protein lattice.

25. Use of a protein lattice according to any one of claims 1 to 24 as a support for the array of macromolecular entities for x-ray crystallography of the macromolecular entities.

26. A method of performing x-ray crystallography comprising supporting an array of macromolecular entities on a protein lattice according to any one of claims 1 to 24 and performing x-ray crystallography on the lattice having the macromolecular entities supported thereon.

27. A protein protomer comprising at least two monomers fused together, the monomers each being monomers of a respective oligomer assembly into which the monomers are capable of self-assembly to assemble at least part of a repeating unit of a protein lattice having a regular structure repeating in three dimensions, wherein, in said protomer, at least a first monomer is a monomer of a first oligomer assembly which is symmetrical in three dimensions.

28. A protein promoter according to claim 27, wherein the first oligomer assembly has a set of rotational symmetry axes extending in three dimensions, and, in said protomers, further monomers fused to the first monomers are monomers of respective further oligomer assemblies which have a rotational symmetry axis of the same order as a respective one of said set of the rotational symmetry axes of said first oligomer assembly,

whereby said repeating unit includes protomers with the first monomers of the protomers being assembled into said first oligomer assembly and, in respect of respective ones of said set of rotational symmetry axes, with further monomers of the protomers fused to respective first monomers being assembled into respective further oligomer assemblies with said rotational symmetry axis of said respective further oligomer assemblies being aligned with the respective rotational symmetry axis of said first oligomer assembly.

29. Plural different protein protomers according to claim 27 or 28, wherein the monomers of the plural different protomers are capable of self-assembly with each other to form the entire protein lattice.

30. A polynucleotide encoding a protein protomer according to claim 27 or 28 or one of the respective protein protomers of said plural different proteins according to claim 29.

31. A vector capable of expressing a protomer according to claim 27 or 28 or one of the

respective protein protomers of said plural different protein protomers according to claim 29.

32. A host cell comprising a vector according to claim 31.

33. A method of making a protein protomer according to claim 27 or 28 or one of the respective protein protomers of said plural different protein protomers according to claim 29, comprising expressing a polynucleotide sequence which encodes the protomer in a host cell and, optionally, purifying the expressed protomer.

34. A method of making a protein lattice according to any one of claims 1 to 24.